Space Weather Technical Forecast

Issued on Sunday, 21 November 2021 at 12:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Active Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES-16. There are two sunspot containing active regions on the visible disc, both small and stable: AR2896 Hrx/alpha and AR2897 Hrx/alpha.

There are currently two large filaments in southern disc, however these appear to be stable at the time of writing. No Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1 was elevated to strong, rising since 20/2300 UTC from around 520-550 km/s to reach 650-680km/s. The solar wind density was generally around 10ppcc, but briefly rose to 10-14ppc between 21/0600-0900UTC. The interplanetary magnetic field strength (IMF) Bt, peaked near 10nT, with a north-south component varying between -6 and +6nT. The phi angle was predominately negative (towards the Sun) throughout. These parameters are consistent with Earth being embedded within the fast wind of coronal hole 20. Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels. The high energy electron flux (greater than 2 MeV) was predominantly at Moderate levels, peaking at 587pfu at 20/1510UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a near-level trend, recording 1.69e7 integrated pfu at 21/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with only a slight chance of C-class flares due to the two small and simple sunspots on the Earth-facing disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Earth's current interaction with the fast wind of CH20 on day 1 (21st) is expected to be the peak of activity for the period, with Quiet to Unsettled conditions, with periods of Active. This falling to mostly Quiet as the currently strong solar winds gradually subside through the period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels. The high energy electron flux (greater than 2 MeV) is expected to rise as geomagnetic activity wanes from the current fast wind. The magnitude of this rise is uncertain, however diurnal oscillations peaking at High flux (greater than 1000 pfu) are likely. The associated 24-hour integrated fluence has a chance of breaching Active (greater than 1e8 integrated pfu) in the period, but likely remaining just below this level.

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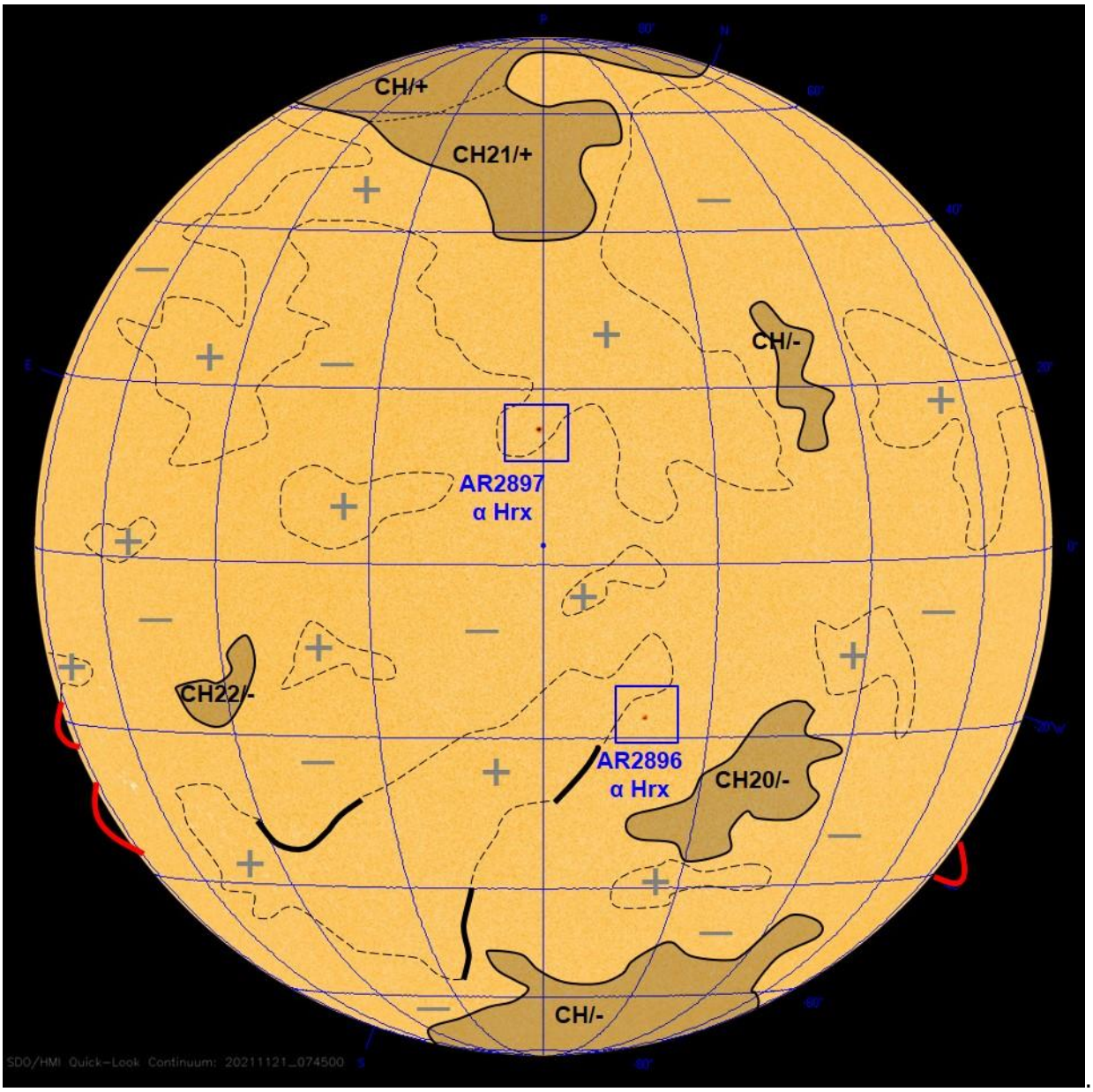
Figure 1. Solar Analysis Valid 21/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Figure 1: H-alpha (El-Teide) of two large southern hemisphere filaments

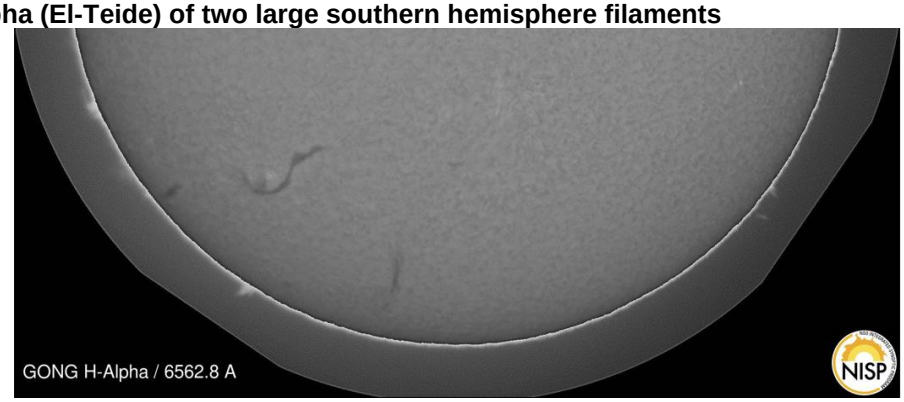


Figure 2: Observed solar winds

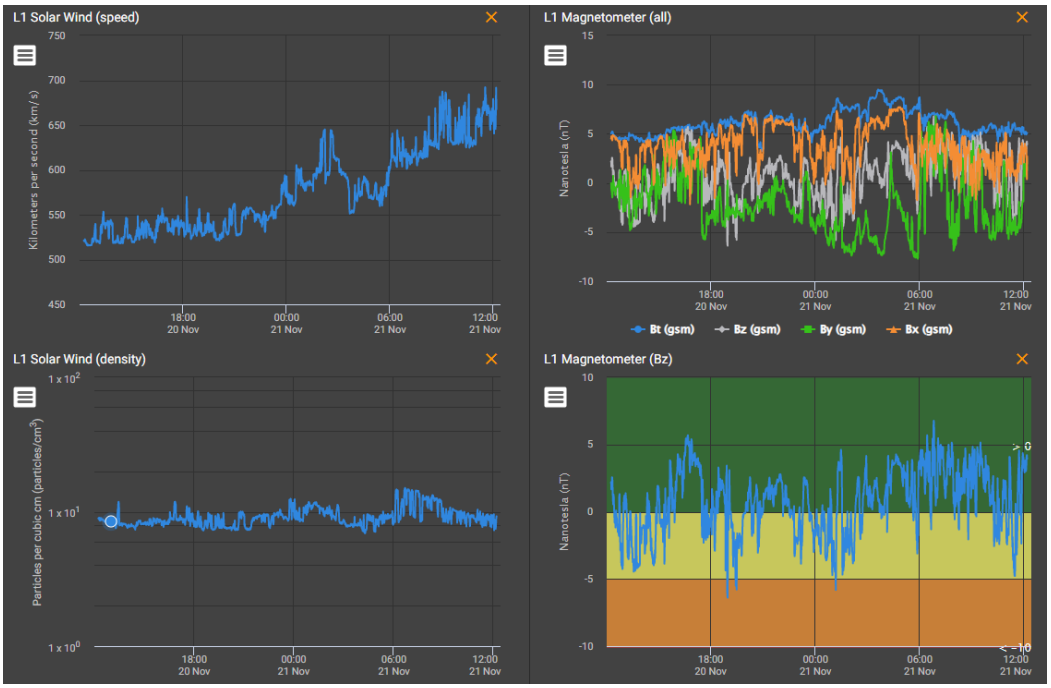
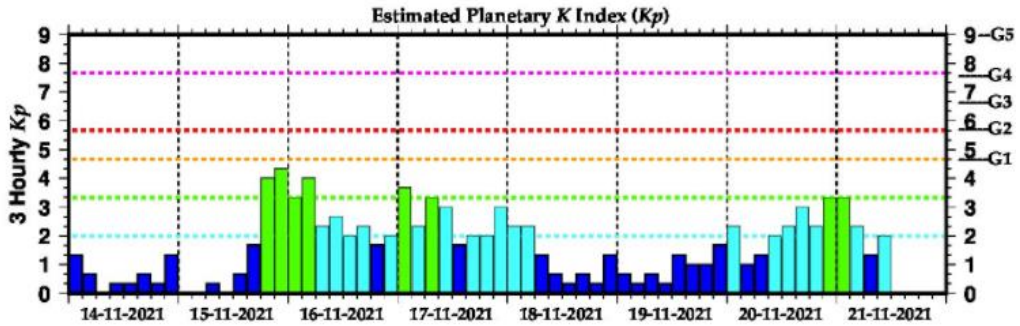


Figure 3: BGS Geomagnetic Activity



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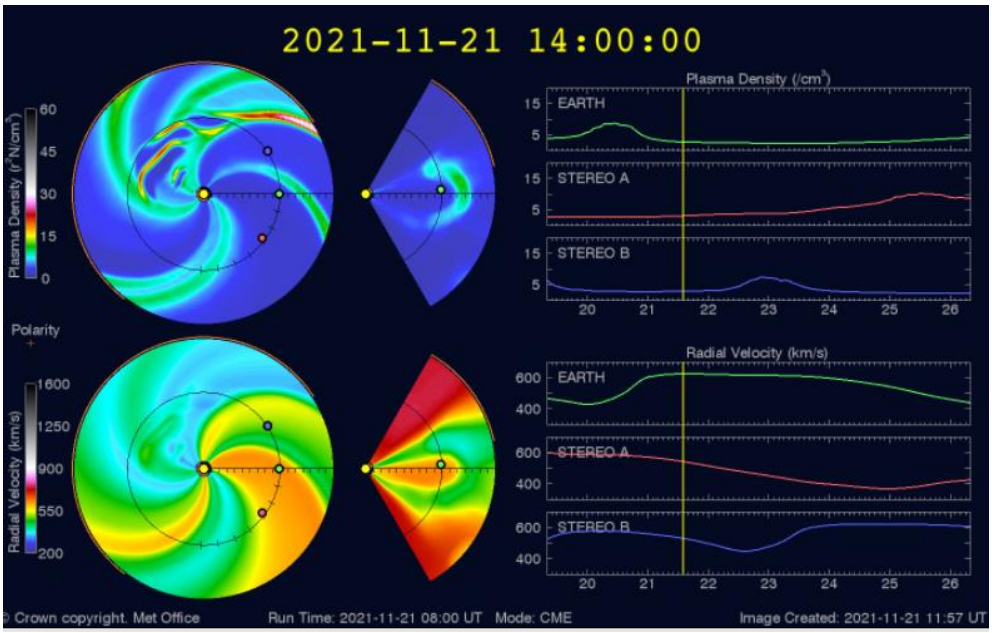
Geomagnetic Storms:

There are no Earth-directed CMEs. The fast wind from coronal hole 20 is likely the main driver of any enhanced geomagnetic activity in the coming four days, with activity expected to peak day one (21st). A new coronal hole appears to have opened in the northwest disc, however as an emergent feature at this location, this is not expected to have a notable impact on the observed solar winds conditions.

Despite solar winds speeds of near 700 km/s being observed at L1, any geomagnetic activity from CH20 fast wind has been remained more muted than expected. Quiet to Unsettled activity is expected with Active periods possible. This activity is expected to continue day 1 (21st) before easing, be to mainly Quiet by the end of the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 4: Enlil showing gradual reduction of solar winds expected



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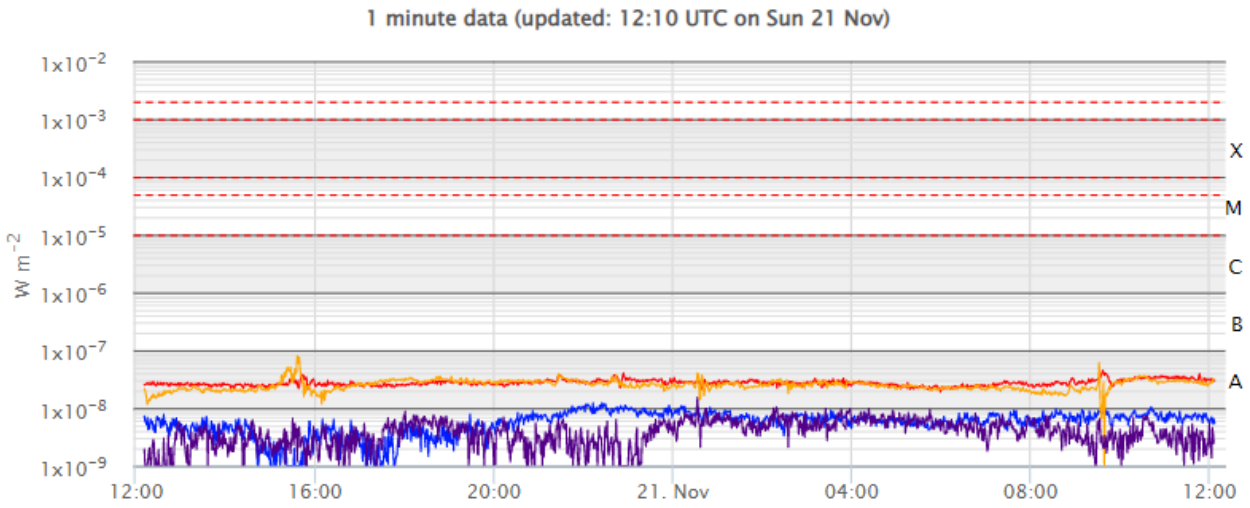
Radio Blackouts - X-Ray Flares:

There are currently two sunspot containing active regions on the visible disc; AR2896 Hrx/Alpha and AR2897 Hrx/Alpha. Both are simple, stable and unipolar spots.

STEREO A EUVI 195 imagery hints that Ex-2891 may lie narrowly over the eastern limb, perhaps impacting on probabilities of flares into the new week, although for now Very Low solar activity is forecast, with a daily slight chance (10%) of C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 5: GOES-16/17 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO has been at mainly Moderate levels, but may rise to High, especially during the diurnal observation peak. This is most likely to occur once any compression of the Van Allen belts from the current fast wind of CH20/- subsides later in this period, day 2 (22nd) onward. This will give a chance of 24-hour electron fluence exceeding Active later in the period, although confidence in this aspect is relatively low, especially due to the lack of a relevant analogue on last rotation.

MOSWOC REFM indicates an increasing risk of breaching Active in the next 72 hours, although the muted geomagnetic response to the fast wind suggests that this risk is lower than REFM signals, and perhaps delayed over its expectations. This potential is maintained in our forecast, although fluence levels are likely to remain below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	20	30	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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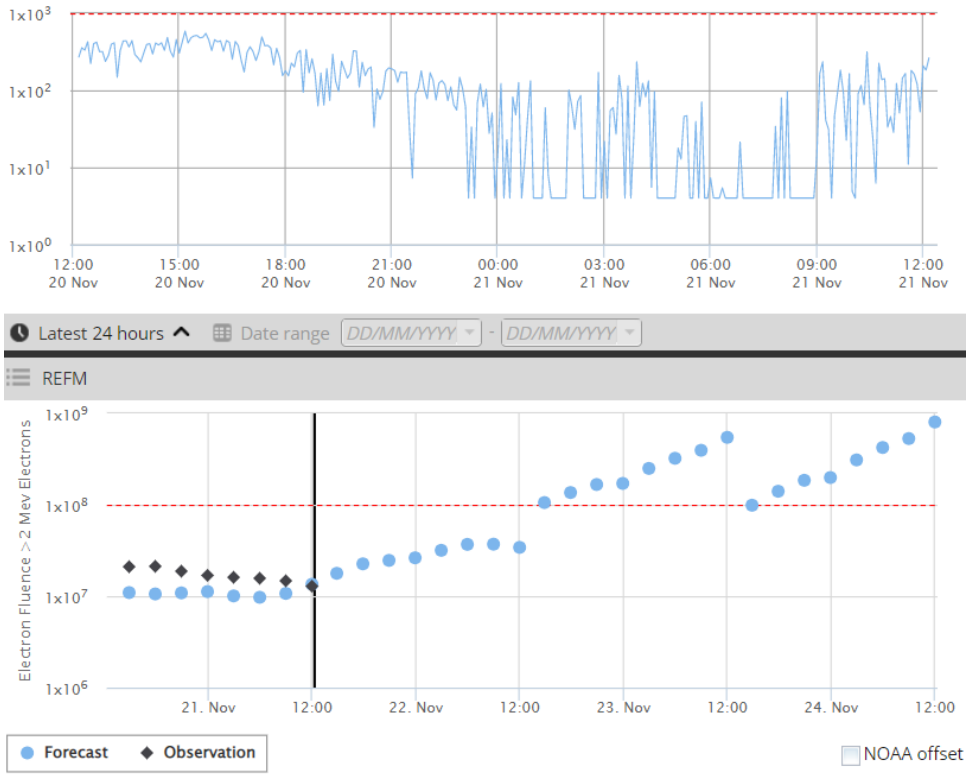
Figure 6: GOES-16 >2 MeV Electron Flux and associated fluence with REFM



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